1200V, 170A, N-channel SiC power MOSFET

General Description:

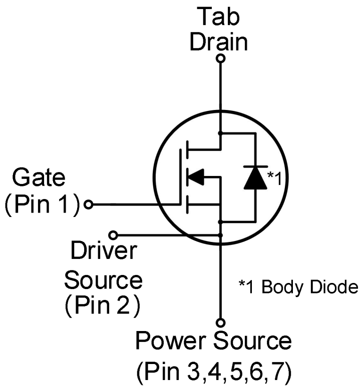
NCES120P013D7 is a SiC MOSFET that contributes to miniaturization and low power consumption of applications. This product achieves industry-leading low on-resistance without sacrificing short-circuit withstand time. This is a TO263-7L package type with a driver source terminal that can maximize the high-speed switching performance that is a feature of SiC MOSFETs.

Features

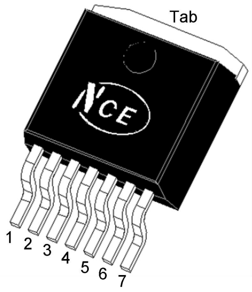
- Low on-resistance
- Fast switching speed
- Fast reverse recovery
- Easy to parallel
- Simple to drive
- Pb-free lead plating ; RoHS compliant

Application

- Solar inverters
- DC/DC converters
- Switch mode power supplies
- Induction heating
- Motor drives



Schematic diagram



TO263-7L

Package Marking and Ordering Information

Device	Device Package	Device Marking
NCES120P013D7	TO263-7L	NCES120P013D7

Absolute Maximum Ratings (T_C=25°C unless otherwise noted)

Parameter		Symbol	Limit	Unit
Drain-Source Voltage		V_{DS}	1200	V
Gate-Source Voltage,max static voltage		V_{GS}	-10 to +24	V
Gate-Source Voltage,max transient voltage (Note 1)		V_{GS}	-11 to +26	V
Drain Current-Continuous (Note 2)		I_D	170	A
Drain Current-Continuous(T_C=100℃)		I_D (100℃)	120	A
Pulsed Drain Current (Note 3)		I_{DM}	425	A
Maximum Power Dissipation	T_{vj} = 25℃	P_D	750	W
	T_{vj} = 100℃		375	
Recommended turn-on gate - source drive voltage		V_{GS_on}	+15 to +18	V
Recommended turn-off gate - source drive voltage		V_{GS_off}	-4 to 0	V
Virtual junction temperature		T_{vj}	175	℃
Operating Junction and Storage Temperature Range		T_J,T_{STG}	-55 To 175	℃

Thermal Characteristic

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction to case	0.2	°C/W

Electrical Characteristics (T_C=25°C unless otherwise noted)

Parameter	Symbol	Condition		Min	Typ	Max	Unit
Off Characteristics							
Drain-Source Breakdown Voltage	BV_{DSS}	V_{GS}=0V, I_D=100μA		1200			V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=1200V, V_{GS}=0V	T_{vj} = 25℃		1	80	μA
			T_{vj} = 175℃		2		
Gate-Body Leakage Current	I_{GSS}	V_{GS}=-10V / +24V, V_{DS}=0V				±100	nA
On Characteristics (Note 4)							
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=20mA	T_{vj} = 25℃	1.9	3.0	4.8	V
			T_{vj} = 175℃		2.1		
Drain-Source On-State Resistance	$R_{DS(ON)}$	V_{GS}=18V, I_D=60A	T_{vj} = 25℃		13	17	mΩ
			T_{vj} = 175℃		19		
Drain-Source On-State Resistance	$R_{DS(ON)}$	V_{GS}=15V, I_D=60A	T_{vj} = 25℃		16	21	
			T_{vj} = 175℃		24		
Gate input resistance	R_G	f=1MHZ, open drain			0.5		Ω
Forward Transconductance	g_{FS}	V_{DS}=20V, I_D=60A			14		S
Dynamic Characteristics (Note 5)							
Input Capacitance	C_{iss}	V_{DS}=800V, V_{GS}=0V, f=1MHz			6300		pF
Output Capacitance	C_{oss}				270		pF
Reverse Transfer Capacitance	C_{rss}				6		pF
C_{OSS} stored energy	E_{oss}				105		μJ
Output charge	Q_{oss}	Calculated by C_{oss}(f)V_{DS}@1MHz			395		nC
Effective output capacitance, energy related	$C_{o(er)}$	V_{DS}=0-800V, V_{GS}=0V			329		pF
Effective output capacitance, time related	$C_{o(tr)}$	I_C=constant, V_{DS}=0-800V, V_{GS}=0V			494		pF
Switching Characteristics (Note 5)							
Turn-on Delay Time	$t_{d(on)}$	V_{DD}=800V, I_D=60A, V_{GS}=+18V / -3V, R_G=2.7Ω, L=200μH			20.2		ns
Turn-on Rise Time	t_r				33.5		ns
Turn-Off Delay Time	$t_{d(off)}$				50.3		ns
Turn-Off Fall Time	t_f				15		ns
Turn-on energy	E_{on}	V_{DD}=800V, I_D=60A, V_{GS}=+18V / -3V, R_G=2.7Ω, L=200μH	T_{vj} = 25℃		888		μJ
			T_{vj} = 175℃		1128		μJ
Turn-off energy	E_{off}		T_{vj} = 25℃		343		μJ
			T_{vj} = 175℃		483		μJ
Total Gate Charge	Q_g	V_{DS}=800V, I_D=60A, V_{GS}=-3/18V			236		nC
Gate-Source Charge	Q_{gs}				73		nC
Gate-Drain Charge	Q_{gd}				74		nC

Electrical Characteristics (T_C=25°C unless otherwise noted)

Parameter	Symbol	Condition		Min	Typ	Max	Unit
Drain-Source Diode Characteristics							
Diode Forward Voltage (Note 4)	V_{SD}	V_{GS}=0V,I_D=60A	T_{vj} = 25℃		3.5		V
			T_{vj} = 175℃		3.2		
Reverse Recovery Time	t_{rr}	T_J = 25°C, I_F =60A, V_R=800V, di/dt = 4160A/μs(Note3)			20.2		ns
Reverse Recovery Charge	Q_{rr}				566		nC
Peak reverse recovery current	I_{rrm}				49.5		A

Notes:

1.t_p < 500ns,D<0.01
2. Repetitive Rating: Pulse width limited by maximum junction temperature.
3. PW ≤ 10μs, Duty cycle ≤ 1%
4. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
5. Guaranteed by design, not subject to production

Test Circuit

Fig.1-1 Gate Charge Measurement Circuit

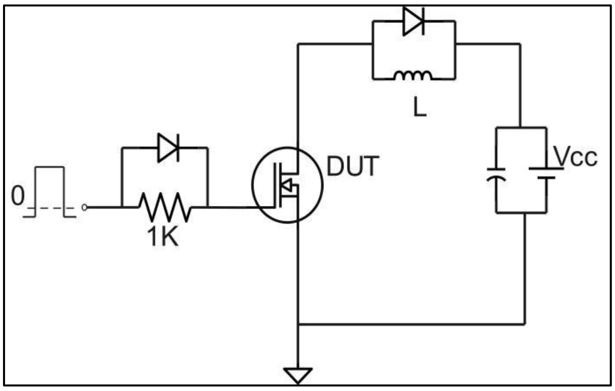


Fig.1-2 Gate Charge Waveform

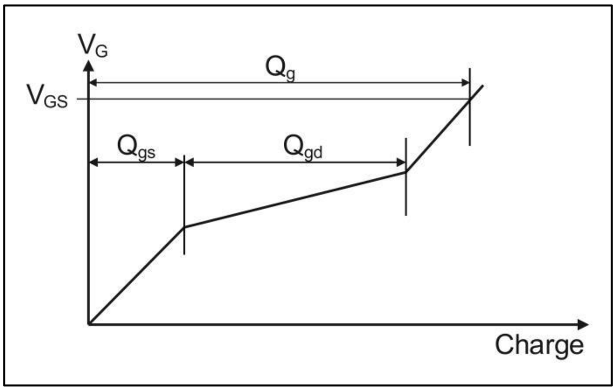


Fig.2-1 Switching Characteristics Measurement Circuit

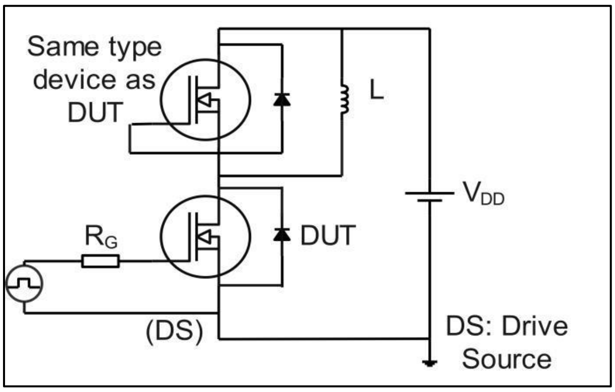
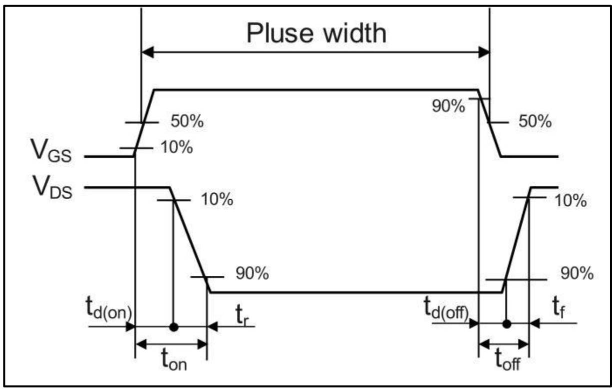


Fig.2-2 Waveforms for Switching Time



Typical Electrical and Thermal Characteristics

Fig.1 Power Dissipation Derating Curve

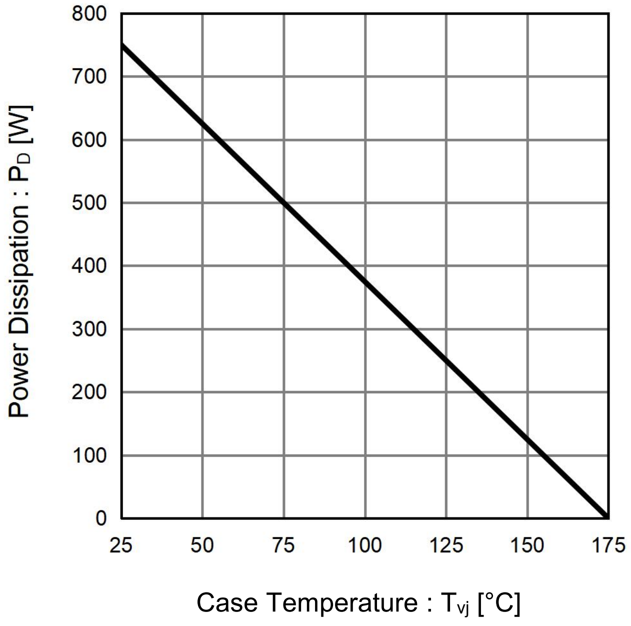


Fig.2 Maximum Safe Operating Area

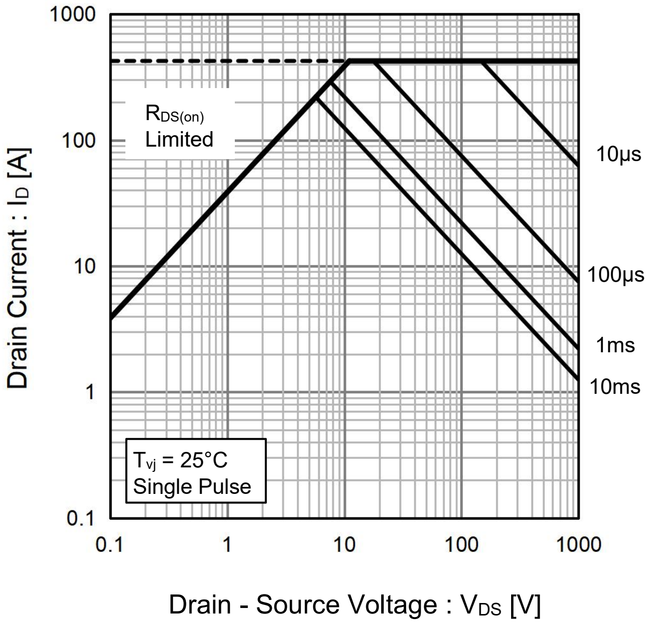


Fig.3 Typical Transient Thermal Impedance vs. Pulse Width

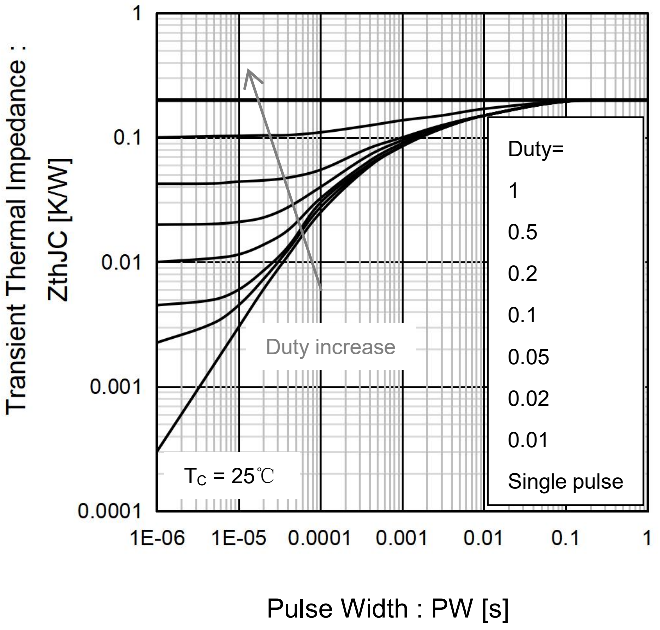


Fig.4 T_{vj} = 25ºC Typical Output Characteristics

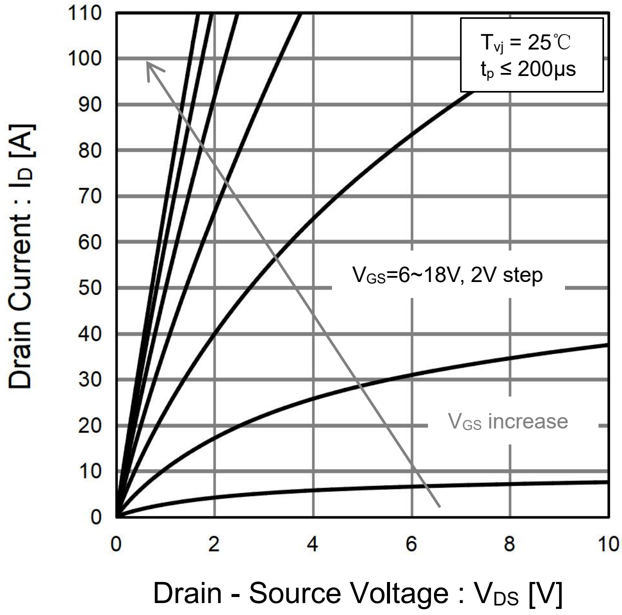


Fig.5 T_{vj} = 25ºC 3rd Quadrant Characteristics

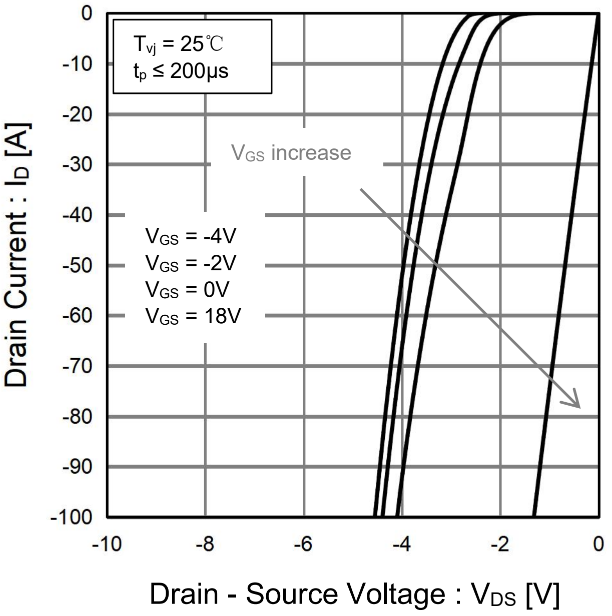


Fig.6 T_{vj} = 175ºC Typical Output Characteristics

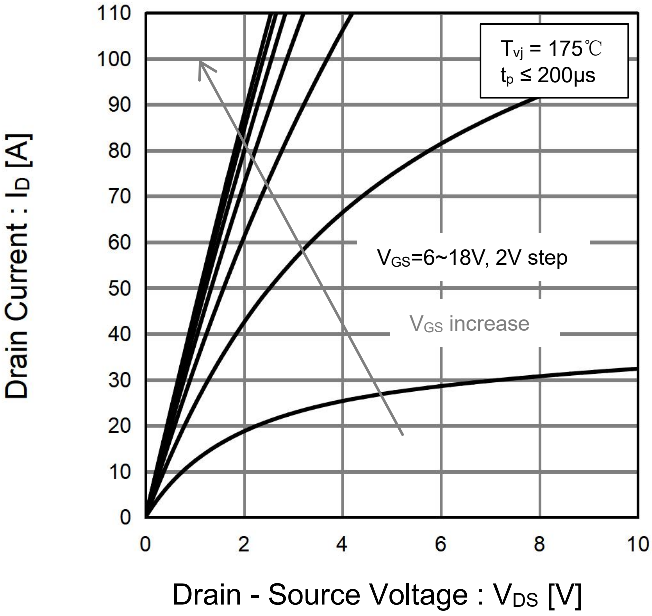


Fig.7 T_{vj} = 175ºC 3rd Quadrant Characteristics

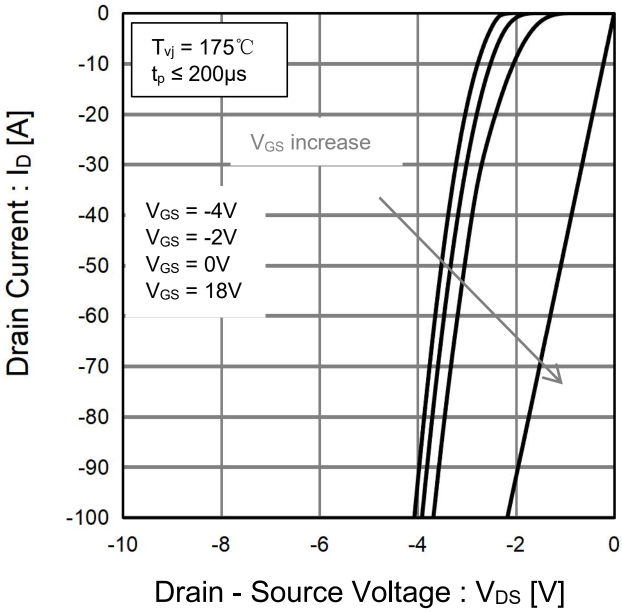


Fig.8 Typical Transfer Characteristics

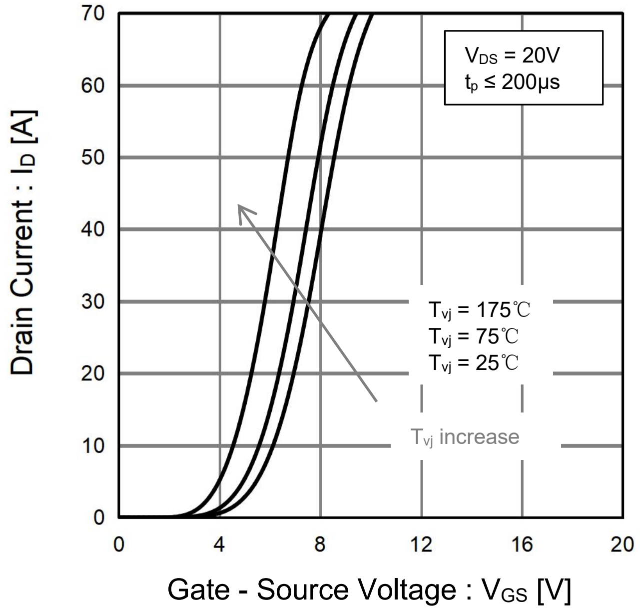


Fig.9 Static Drain - Source On - State Resistance vs. Gate - Source Voltage

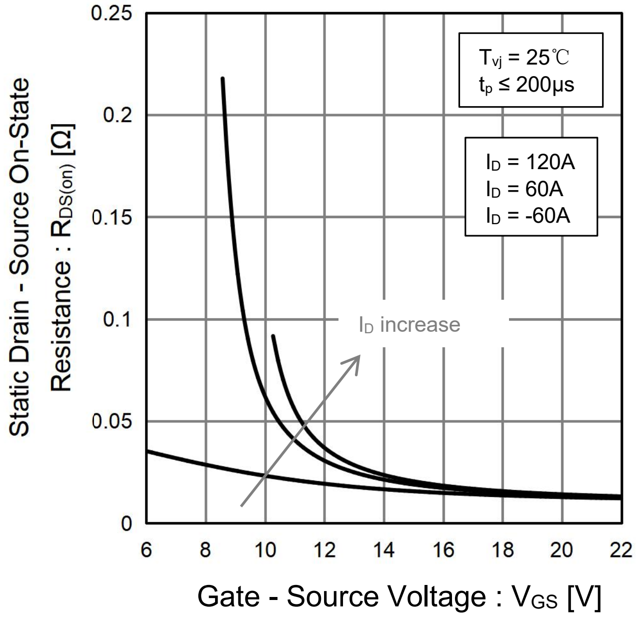


Fig.10 Static Drain - Source On - State Resistance vs. Drain Current

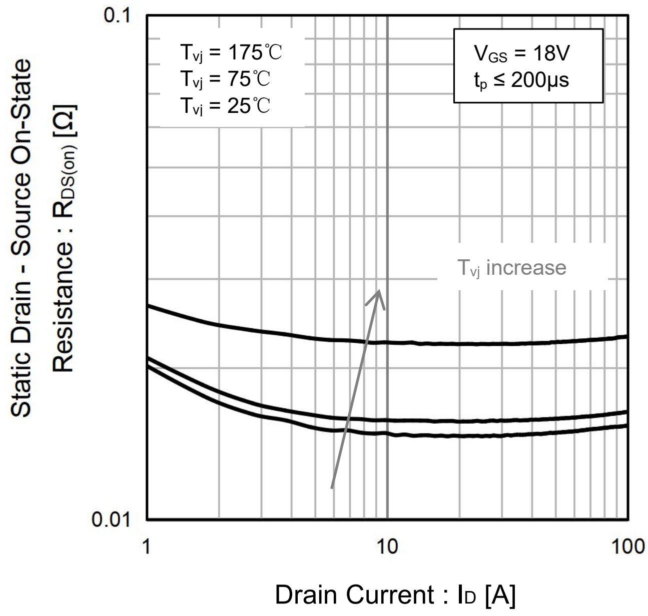


Fig.11 Static Drain - Source On - State Resistance vs. Virtual Junction Temperature

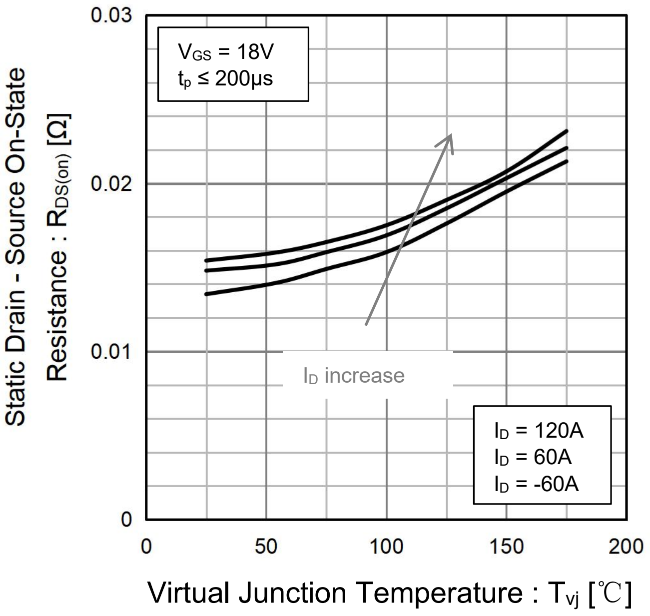


Fig.12 Body Diode Forward Voltage vs. Gate - Source Voltage

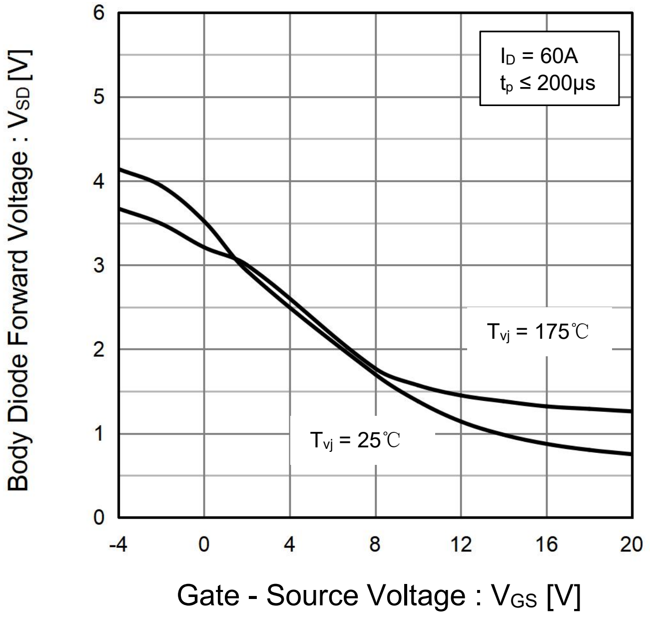


Fig.13 Gate Threshold Voltage vs. Virtual Junction Temperature

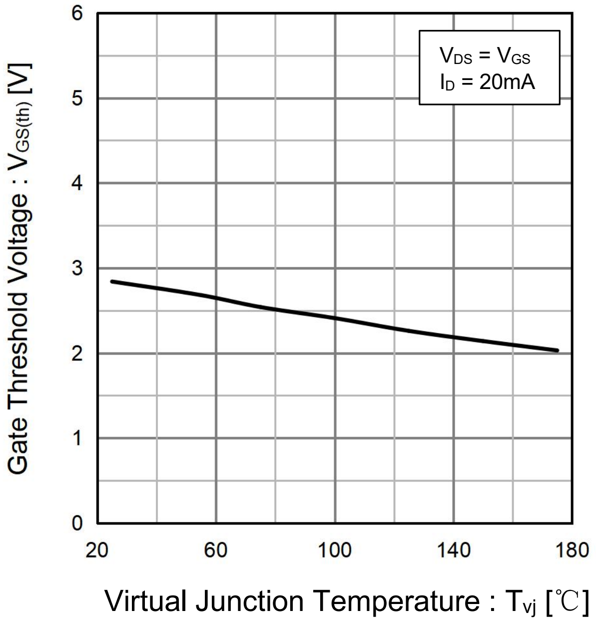


Fig.14 Typical Capacitance vs. Drain - Source Voltage

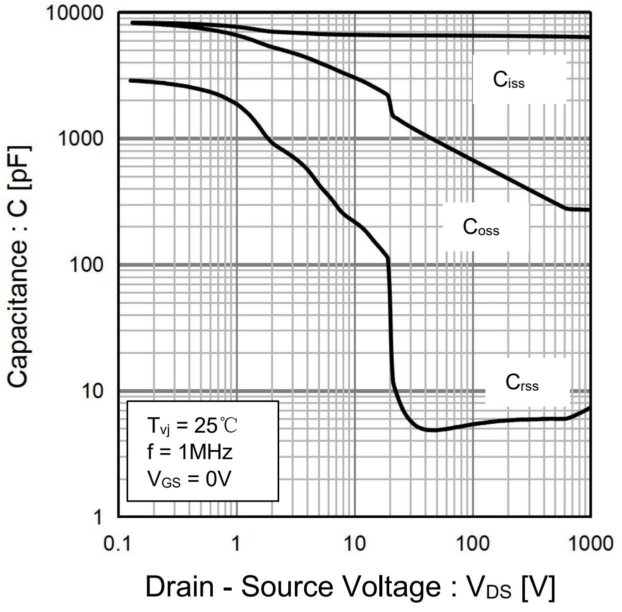


Fig.15 COSS Stored Energy

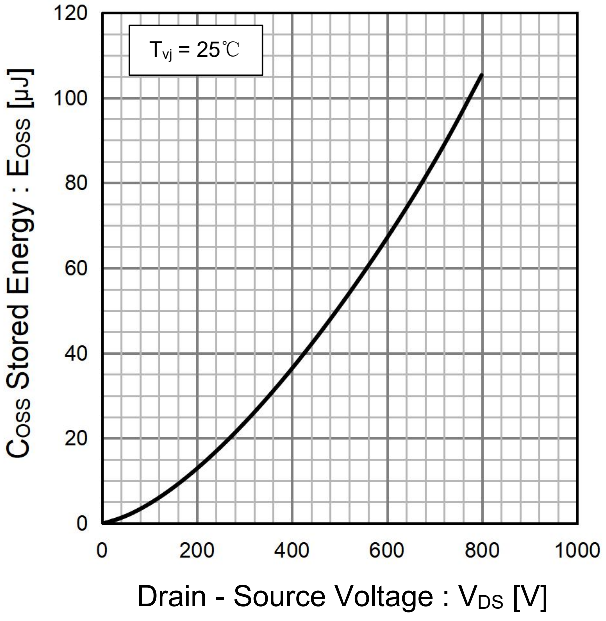


Fig.16 Dynamic Input Characteristics

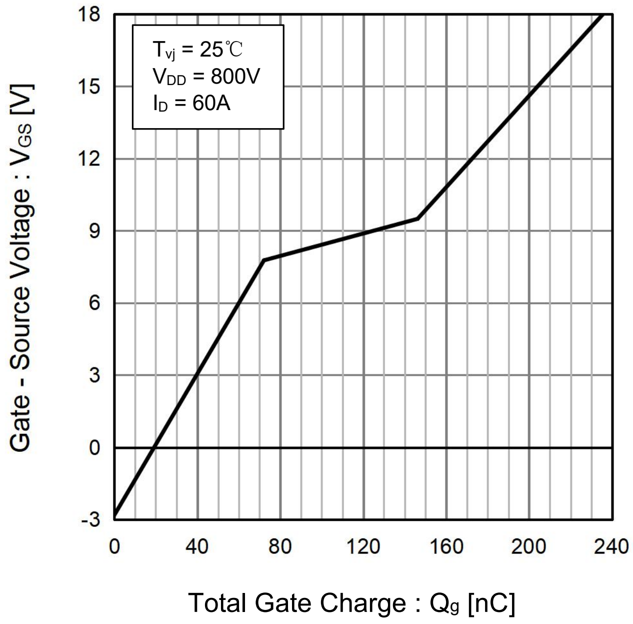


Fig.17 Typical Switching Time vs. External Gate Resistance

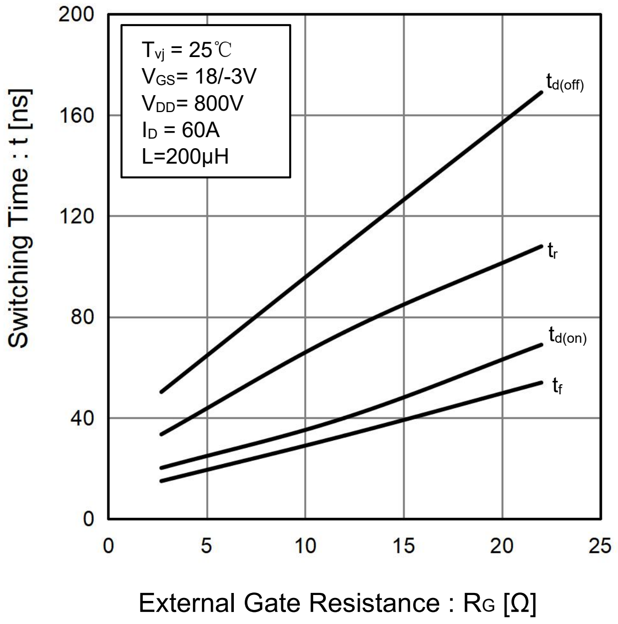


Fig.18 Typical Switching Energy vs. External Gate Resistance

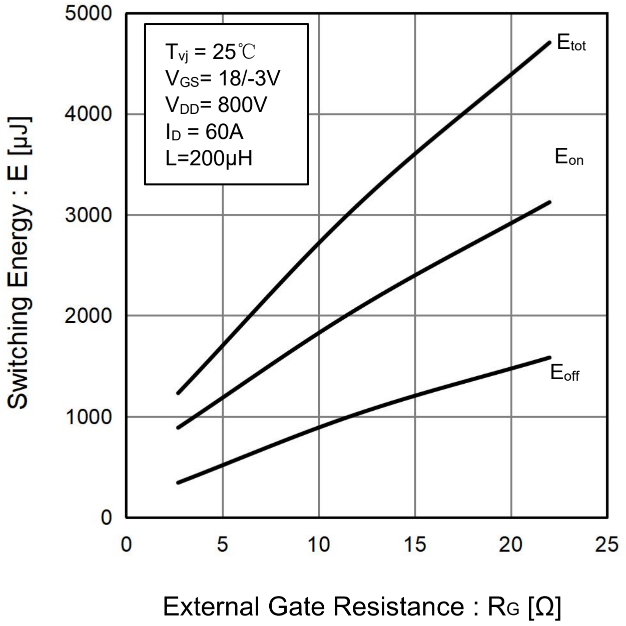


Fig.19 Typical Switching Energy vs. Drain Current

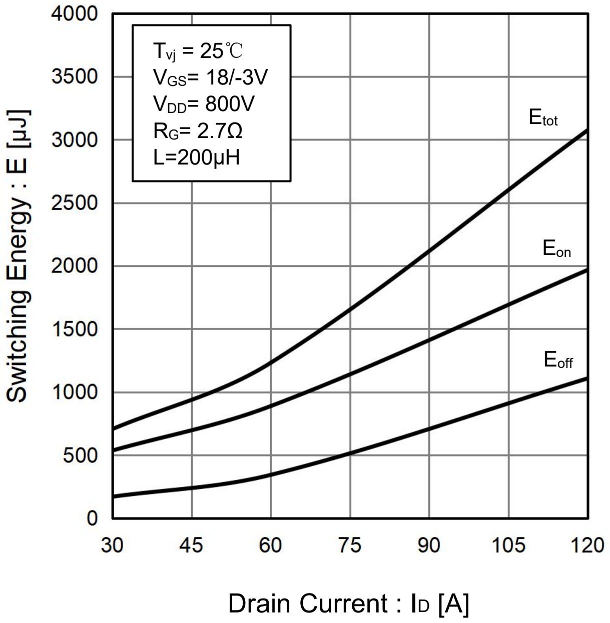
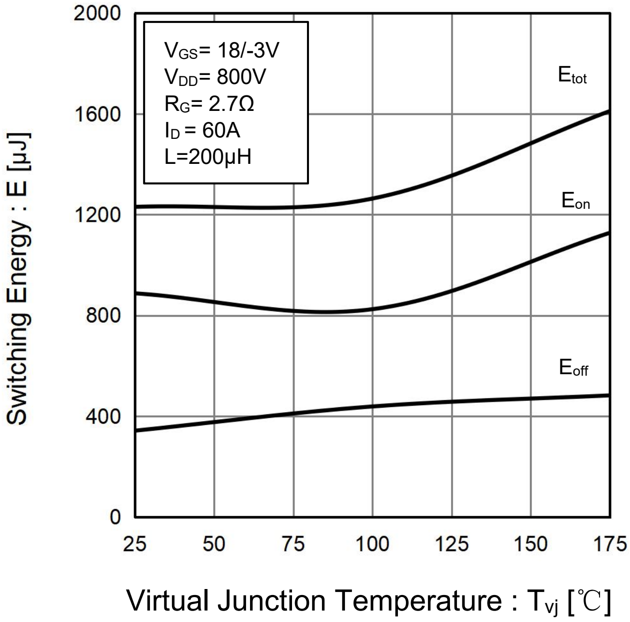
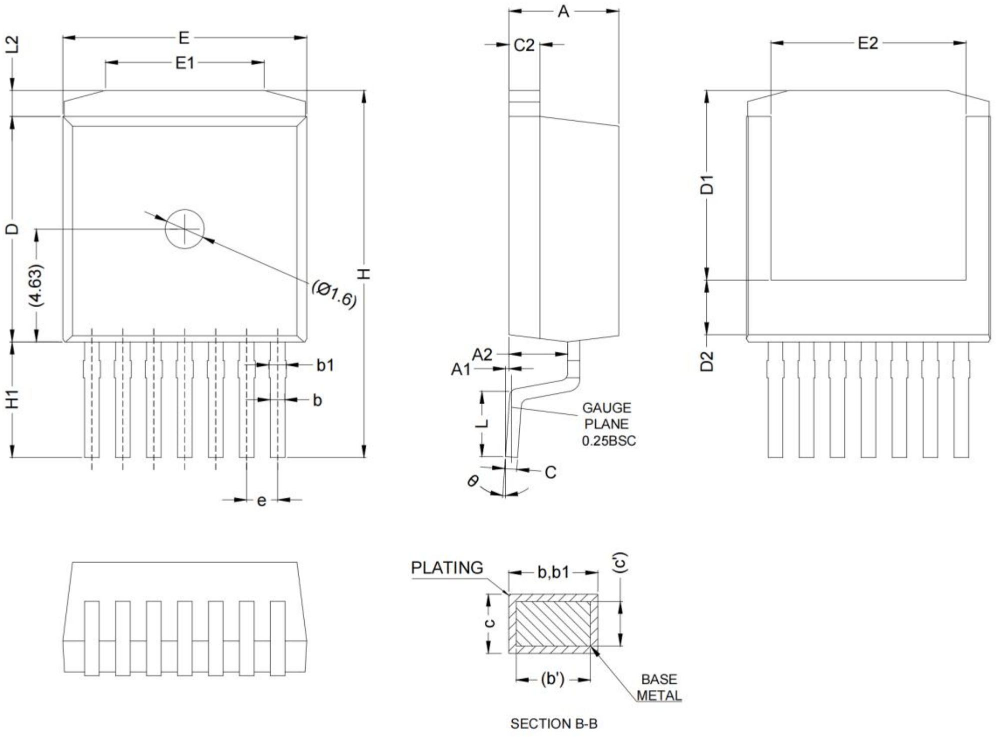


Fig.20 Typical Switching Energy
vs. Virtual Junction Temperature



TO263-7L Package Information



Items	Min	Max
A	4.30	4.70
A1	-	0.25
A2	2.20	2.60
b	0.52	0.72
b'	0.50	0.70
b1	0.60	0.80
c	0.42	0.62
c'	0.40	0.60
c2	1.07	1.47
D	9.05	9.45
D1	7.58	7.98
D2	2.05	2.45
e	1.27 BSC	
E	9.80	10.20
E1	6.30	6.70
E2	7.80	8.20
L	2.48	2.88
L2	0.87	1.27
H	14.87	15.27
H1	4.55	4.95
θ	0°	8°

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